AN ESSAY TOUCHING THE Gravitation, or Non-gravitation OF FLUID BODIES, And The Reasons thereof.

By Ld Matthew Hales

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CHAP. I.

The Introduction.

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And I must needs commend the Industrie of this latter Age, in the inventing and exhibiting of very choice Experiments, as in relation to some other Philosophical Essays, so in particular, touching this Phenomenon of the *Gravitation or Non-gravitation of Fluids.*

But yet I must further add, that though their Experiments herein have been searched out, and formed with great Ingenuity, Industry, Curiosity and Expence; yet their Solutions of them, and the Suppositions and Reasons whereunto they have reduced them, have been (in my understanding) very unsatisfactory and inevident, if not wholly untrue and inexplicable,

And the reasons hereof seem to be principally these, *viz.* 1. That men have pre-ingaged themselves and their judgments in the assertion

on and maintainance of certain preconceived Hypotheſes and Principles which they have invented, and are therefore extreamly addicted to, and unwilling to hear or receive any thing that may render their Labour herein vain and fruitleſs. And upon that account, have, not without much partiality, miſapplyed and miſappropriated their Experiments and the Solutions of them, in favour of ſuch Hypotheſes as they have once invented or entertained, and with too much prejudice, reject any other Solutions, that may either overthrow, or at leaſt not gratify ſuch preconceived ſuppoſitions. 2. That men have not ſtrictly enough conſidered of the Nature of Gravitations, and the Reaſon thereof. 3. That they have not enough taken into conſideration thoſe ſeveral accidental (as I may

call them) Interventions that abate, impede, advance, or direct the Gravitation of Bodies, though in themselves heavy, and tending to the Centre.

I do not intend to make a full Tract concerning Gravity or Gravitation; those that mind to trouble themselves therein, may at their leisure consult those Excellent Men that have written at large of this subject, as *Archimedes de insidentibus humido*. *Mersenius*, and *Stevinus* their Hydrostaticks; and although I cannot subscribe to all that the two latter have written in this subject, yet I must needs say, that I think little of moment hath been added to their Principles and Demonstrations by later Writers, only some new Experiments have been added by later Writers, bottom'd upon the Doctrin and Experiments of these Ancients.

I ſhall therefore direct all I have to ſay principally to this one matter or point, namely, the Gravitation or non-Gravitation of Fluids upon ſubjected Bodies, and the degrees and reaſons of this *Phænomenon*.

And though it may poſſibly happen, that what I ſay herein may as little ſatisfie others, as their ſuppoſitions have ſatisfied me. And though my Explications of my thoughts herein, and the application of my Experiments thereunto may not be ſo clear and well worded as others of this Subject have been, yet I have this Apology for theſe defects; 1. That what I now write, though it hath been long upon my thoughts, was written *raptim* and haſtily. 2. That I do not know that the Path I walk herein was ever before troden by any elſe. 3. It is but an Eſſay, and

took not up many hours in writing, and will take up much leſs in reading thereof.

And this I premiſe, not to arrogate ſingularity to my ſelf, or to pleaſe my ſelf in being the firſt inventor of this Explication; for poſſibly it may fall out, that it may be ſcarce worth the owning, when well examined by better Judgments, and poſſibly I my ſelf may retract ſome things in it, upon better reaſon diſcovered: Yea, and poſſibly it may fall out, that ſome others have had a more early conception of it than my ſelf, and may have dreſſed it in better order; and indeed it would be ſome confirmation to me, if it were ſo, though I have not yet known or heard of any ſuch Anticipation.

I have ſeen many men very confident in the ſuppoſitions which they have found out; and yet upon

on full examination, their miſtakes have been diſcovered: And although I think that I have laid down true ſuppoſitions, yet I will not be over-confident of them; for I may be over partial to my ſelf, as I find others are to themſelves and their ſuppoſitions; and it is not the confidence of the Author, but the Evidence of Reaſon, that prevails with ſober men; and therefore I do propound them but as Eſſays, and ſubmit them to further examination.

And the reaſon why I offer it to the publick view is, that better Judgments than my own may conſider it; and though poſſibly they may not in all things approve it, or the manner of its Explication, yet they may by this opportunity, either improve it if they allow it, or make ſome uſeful ſuperſtructions upon it, for the farther diſco-

very of this noble Problem; as Arithmeticians do by the Rule of False Position, make true Conclusions, or at least may desert the vanity of this or any other opinions formerly offered touching the Solution of this *quæsitum*, and offer better.

CHAP.

CHAP. II.

Of Gravity and Gravitation, and the true Reaſon of the latter.

GRavity it ſelf ſeems to be an Intrinſecal quality of Bodies; whereby they tend downwards to, or towards the Centre of the Earth.

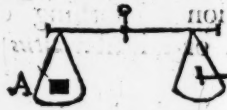
I am not here to trouble my ſelf with theſe Philoſophical Queſtions, whether there be any other Centre of Gravity than the Centre of the Earth for weighty Bodies? Nor what is the prime cauſe of deſcent of heavy Bodies, whether any Magnetical quality in the Earth, or any forcible extrinſecal Impreſſion by the Motion of the Heavens, or heavenly Bodies, or that Circumpulſion of other Bodies, that ſome have imagined,

gined, or any Intrinſick form of the heavy Bodies themſelves, which is analogical to a vital principle, exerts this power. But it ſerves my turn at this time to call it an Intrinſick Quality of heavy Bodies. Gravitation is either Motion it ſelf, or the *conatus* or *niſus ad motum*; and therefore it is (that according to that *linea directionis*, whereby, or according to which the Motion of Bodies are directed) not improper to ſay, that according to that Line of Direction, theſe Bodies do *gravitare*; and although ordinarily the Line of Directions of heavy Bodies, naturally is towards the Centre of the Earth in a perpendicular deſcent, which is the ordinary motion of Gravitation, and is greater or leſſer according to the ſtrength, weakneſs, or allay of this *niſus* or *conatus*: Yet it is not altogether incongruous

ous to ſay, that every thing that hath a *niſus* or *conatus ad motum*, doth in ſome ſort Gravitate according to the Degree and Line of ſuch Direction; and thus Fluids, though the primitive Line of the Direction of their Gravitation, may be perpendicular, yet Fluids have for the moſt part a natural Direction or Gravitation otherways, and ſome Fluids may have an Accidental Gravitation otherways. For inſtance, Water, though it have its primitive Line of Direction of its motion downward to the Centre, yet it hath Lines of Direction of its Motion otherways, as Laterally, or *per declive*, and in ſome inſtances *per aſcenſum*, (whereof hereafter,) and conſequently Gravitates every of thoſe ways. For, as I ſaid before, Gravitation is nothing elſe but Motion, or at leaſt *conatus* or *niſus ad motum*. And

And therefore it is no real incongruity to ſay, that Fire or Gunpowder doth Gravitate in its Lines of Aſcenſion or Expanſion; that the Bullet, when ſhot upright, doth Gravitate *aſcendendo*, when it is ſhot level it Gravitates *horizontally*, as long as that force prevails againſt its natural motion of Deſcent. For as to this purpoſe, Gravitation is nothing elſe but *motus*, or *niſus ad motum ſecundum in lineam Directionis ejuſdem.*

And therefore it is, that when a weight of 10 or 20l. is in the Scale *A*, and nothing in the Scale *B*, a Percuſſion with a Hand or Hammer in the Scale *B*, that moves the Scale *A* with its weight from the Horizontal Plane, wherein it ſtands, is truly ſaid *prægravitare* to the Weight and Scale at *A*.



CHAP. III

Concerning the Gravitation of Solid Bodies, and their parts.

IT is moſt certain, that every Solid Body, ſeparate from the Earth, hath an actual Preſſure or Gravitation, or *conatus ad motum* towards the Centre of the Earth, as its proper Line of Direction; (I ſpeak not here of the Centre of Gravity of the Bodies themſelves, *de quo vide ſis Galdinum Gondicburldum, & Stephinum.*) Yea, if a Body be a Fluid Body, yet if it be ſevered from a Body of its own nature by a Veſſel containing it, this Fluid Body in this conſiſtency, obtains the natural rule and reaſon of a Solid Body, conſiſting of the Water and the Veſſel containing it. As, for inſtance,

inſtance, Water in a Pail or Bucket, as ſo ſtated, hath in it the nature of a Solid Body, and the Gravitation thereof is perpendicular to the Centre, which is its proper Line of Direction. And ſo Air included in a Bladder, though it ſwims in Water, yet doth Gravitate in ſome meaſure as other Solid Bodies do, and deſcends naturally to this Centre: yea a portion of Water by it ſelf, being poured out of a Veſſel from the top of a Tower or Steeple, hath its Line of Direction through the Air to the Centre, and will follow and Gravitate in that Line of perpendicular Deſcent. For though it be a Fluid Body in it ſelf, yet relatively to the Air, being a lighter Body, through which it moves, it is in the nature of a Solid Body; and yet in a great Deſcent the Acceleration of its motion, and the renitence of the Air will break

it

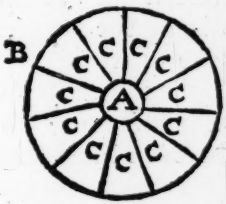
it into Drops or Dew, before it comes to the bottom in a great Deſcent.

But though Solid Bodies do actually Gravitate, yet if they be continued, the parts thereof do not Gravitate one upon another, becauſe mutually and mechanically ſuſtained one by another, and in a ſtate of Continuity: as a Bowl of Ebony that may weigh 10l, yet the upper Parts or Quarters thereof, whiles in Continuity, do not gravitate upon the lower; for if a hole were bored through the Bowl, yet the upper parts thereof would not gravitate upon the Cavity, for the reaſon before given.

And therefore the vaſt body of the Earth doth not gravitate upon its own Centre, becauſe though all the parts thereof are perchance not ſimply continued as a Stone or piece of Wood; yet partly by their mu-

mutual Compreſſion one to another, and partly by the Intervention of the cement of Water, they are *quaſi unum continuum.*

Again, if we ſhould ſuppoſe that the vaſt body of the Earth were divided into ſeveral ſolid inverted Cones or Pyramids, and that the Centre of the Earth were a leſſer Globe of ſoft Wax or Quick-ſilver, or other ſoft Matter, ſuppoſe a Mile in Diameter; and that each Cone or Pyramid, having a part of the acute end cut off, to be contiguous to this Globe of Wax; yet it were impoſſible that they ſhould preſs or gravitate upon that Globe of Wax, becauſe they would be each ſupported one by another, as will appear by the following Figure.



A the Globe of Wax in the middle of the Earth, *B* the Earth, *ccc* the ſeveral divided inverted Cones. For the upper Baſe of every Cone being larger than the acute part thereof, every Cone will be ſupported by his fellow without any gravitation upon the Clobe, as *A*.

Yea, and it would fall out to be in the ſame manner, though we ſhould ſuppoſe that the Globe of the Earth, which ſome have ſuppoſed to be 7000 Miles Diameter, ſhould be but 1000 Miles in Earth, and the other 6000 Miles to be a Globe of Water, or ſome fluid Body,

for the reaſon before given.

And this by the way may ſhew the miſtake of their ſuppoſition that think the impendent Column of the Atmoſphere, which they think to be ſeven Miles high, is a bare Column commenſurate in its top and bottom, for it cannot be ſo, but at the moſt is an inverted Cone or *Pyramis*, conſiderably wider at ſeven Miles diſtance then it is at the Earth: which if conſidered, would trouble their Explication of the *Torricellian* Experiment, upon an account of the actual Gravitation of a Column of Air.

CHAP.

CHAP. IV.

Concerning the Gravitation of Solid Bodies in Contiguity, and not in Continuity.

THE laws of Statiques do infallibly demonſtrate, that the weight *A* incumbent upon the ſtaff *B*, which at both extremities is ſupported by *C* and *D*, that *C* bears but one half of the weight *A*, and *D* the other half.

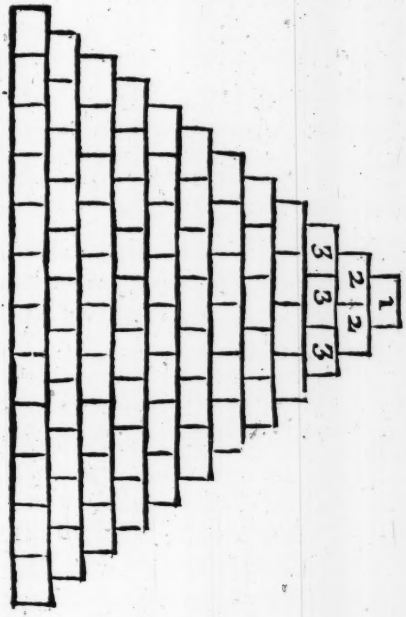
And conſequently if there were another Staff ſet on croſs from *E* to *F* of the ſame length, each Supporter

ter would bear but a fourth part of the Weight.

This being premiſed, I ſhall now conſider the Gravitation of Solids not united and cemented together, either by Contunity of parts, or that which may be equivalent, Lime, Cement, or Morter, as in Brick-wals or Houſes, but of ſuch Solids as are united onely by Contiguity.

I will therefore ſuppoſe a *Pyramis* (or if you will a Pillar or Wall, for it will come all to one paſs) having a foundation of twelve Stones, every way a Foot ſquare, and piled up one upon another, breaking off joint according to Art of Maſoncy, but

but without Cement or Morter; ſo that it will be twelve Foot ſquare at the Baſe, according to this Figure, and conſequently the *Area* at the Baſe be 144 ſquare Feet,



In this Figure theſe things are obſervable.

The upper Stone marked (1) is ſupported by the four next Stones upon which it is bottomed, and each of theſe four Stones bear but a fourth part of its weight; the next Row of Stones (being nine) bear each of them but a ninth part of the uppermoſt; and the four next, which is proportionably abated to the lowermoſt Rows. Now ſuppoſe that the ground or *baſis* whereupon it reſts ſubjected under the middle of the *Pyramis*, namely the ſquare of ſixteen ſquare Stones, which make ſixteen ſquare Feet, were gently taken away; yet there would not thereupon ſink a Column of ſixteen ſquare Feet extending to the top of the *Pyramis*, for two plain Mechanical Reaſons.

1. Becauſe that Column is not merely ſupported by the baſe of ſix-

teen

teen ſquare Feet, but by the reſidue of the whole Pile; and it would ſtand like an Arch over that Cavity, which would happen upon the removal of theſe fourteen Stones, and thoſe that are entirely ſupported by them.

2. Becauſe the weight & the renitence of the reſt of the Pile would keep up the *Pyramis*, if it had a ſufficient weight by the reſidue of the Pile to bear one againſt another.

And ſo the reſidue of the *Pyramis* would ſtand without any Gravitation upon that Cavity, which would be left by the ſubſiding of thoſe ſixteen Stones, and thoſe that are meerly ſupported on them, without any actual Gravitation upon that Cavity that is left, but onely upon the reſt of the Baſe of the *Pyramide*; onely thoſe Stones that were entirely ſupported by the ſixteen ſubſiding Stones would

ſink with it, and leave a Cavity like an Arch, maintained by the reſt of the *Pyramis*, according to this enſuing Figure,

ſuppoſed to be the empty place of thoſe ſixteen ſubſiding ſtones, with thoſe entirely ſupported by them, *viz.* nine, four, and one. And this Inſtance I have given of ſquare Stones, to explain the reaſon of the thing: for it will hold in ſmaller and more irregular bodies.

Suppoſe there were a laying of a Floor of grains of Wheat, in a Floor of about 42 Foot circumference, and place an Egg, nay an Egg-ſhell, or Glaſs-bubble perforated, that there may be the leſs pretence of reſiſtance by its plenitude of

of Air; let this Egg-ſhell or Bubble be placed in the middle of this Floor, that it may not be injured meerly by the hardneſs of the floor, then gently cover it with more Wheat of about a Foot deep, then pour upon it 20 or 40 Buſhels of Wheat; that the Egg-ſhell or Bubble may lie above ten Foot under the top of the Heap; yet this Egg-ſhell or Bubble ſhall not be broken: and yet take a Glaſs or wooden hollow Cylinder, commenſurate in baſe to the Egg-ſhell or Bubble, and four Foot long, ſtopped at the bottom, and lay it gently upon the Egg-ſhell or Bubble, it ſhall with its weight cruſh it to pieces.

And the reaſon is,

1. Becauſe that every ſubjected grain of Wheat bears two, three, or four above it, and ſo the Egg-ſhell is not preſſed with the weight of a whole Cylinder of Wheat of ten

ten Foot in height, and proportionable in the baſe to the extenſion of the Egg-ſhell, but at the moſt with a ſmall little Cone of Wheat, perchance not two Inches high; ſo that the Egg-ſhell and its little Cap or Cone of Wheat ſtands as under an Arch, ſupported by the reſt of the Grains in the whole Heap.

2. Although the Grains of Wheat are of viſible and conſiderable bulk, yet the poſition of the Heap of Wheat directs every Grain of Wheat poured upon the Heap accidentally to a lateral preſſure *per declive*, which refracts their perpendicular Gravitation. But of this more particularly and evidently, when we come to the Gravitation of Fluids.

And in conformity to theſe, or one of theſe Reaſons, I took a Cylinder of Deal boards nailed together, and open at both ends, of about

two

two Foot long, and six Inches square in the concave Diam. and took two halves of an Egg-shell, emptied, and clapped them together, which would not sustein half a Pound weight put upon them, without a total crushing of them.

This Egg-shell I laid in a little bed of *Calice* Sand, and then putting my hollow Cylinder upon it, and poured into it gently *Callice* Sand, till I had filled my Cylinder to the top, which contained about four Pound weight of Sand, and that very dry, and then upon the Sand I placed about six or seven pound weight of Lead, and carefully laying down my Cylinder of Sand, I found yet my Egg-shell in the same state as at first, without the least bruising, yea and lifting up the Cylinder of Sand, I found it so compacted, that it would not wholly go out, but remained suspended in the

the body of the Cylinder, which I attributed, and (as I think) truly to the lateral preſſure of the Sand upon the ſides of the Veſſel, whereby theſe minute Particles were driven to lean one againſt another ſo hard, that they retain'd a kind of Solidity by this renitence.

And I think in this Experiment I have no need to have recourſe to an Intelligent Hylarchical principle that ſuſpended the Sand from Gravitation, nor to that other difficult Solution from the Texture of the ſubjected bodies; but merely to thoſe two formerly mentioned, *viz.*

1. That each Particle of Sand ſuſtained mechanically the incumbent Particles, and left my Egg-ſhell as it were under an Arch, being preſſed not with a Cylinder of Sand proportionable to its baſe, but at moſt with a ſmall Cap or Cone of Sand, that did not conſiderably gravitate upon it.

2.

2. That though the Sand is no fluid body, yet the ſmalneſs of its Corpuſcles had an accidental lateral Direction *per deelive* againſt the ſides of the Veſſel, which lateral Direction refracted the perpendicular Gravitation of the Sand, as will be ſhewn more, when we come to conſider of the Gravitation of Fluids, which may be illuſtrated by this Inſtance.

And becauſe I propoſed to proſecute this Tryal farther, I made an Experiment by a heavier body, namely Leaden Hail-ſhot.

I took a Cylinder of Latten ware, about two Inches in Diameter, and 10 Inches deep, open at both ends, which held about ſix Pound of Shot. I placed it cloſe to a Table, and filled it, and then gently taking it from the Table, the Shot ſubſiding expanded into a compaſs of a Foot Diameter.

I then took the end of an Egg-ſhell, compreſſible with leſs than a Pound weight, placed it in a little Box that was receptible within the cavity of the Cylinder, and filled it up round with Shot, that it might not receive injury by the fall of the Shot through the Cylinder, and then clapping the Cylinder upon it, filled it up with about ſix Pound of Shot; but upon the opening of it the Egg-ſhell was not damnified.

Then I tried it by an Inſect, namely putting in a Beetle into the box, and covering him with Shot, ſo that the fall of Shot from a higher place might not damniſie him; then putting my Cylinder over the box, filled it up with ſix Pound of Leaden Shot, and then opening it, I found my Beetle as lively as before, yet a weight of Lead in one ſolid body, commenſurate to the baſe of the

the Beetle would have cruſhed him to pieces.

So that the Non-gravitation of theſe ſinall bodies of Sand, Grannet, and Shot, may ſufficiently prepare our minds to apprehend one of the reaſons of Non-gravitation of Fluids, which though fluid, yet are not diſjoined as in thoſe former Inſtances, but a continued body, and therefore the upper Particles thereof more capable of ſupport from thoſe ſubjected Particles.

CHAP.

CHAP. V.

Concerning the Gravitation of Fluids upon ſubjected Bodies, and firſt of the Gravitation of Water.

SOme things muſt be premiſed, before I come to the main matter I intend herein.

1. That it is certain Water hath an intrinſecal Gravity of its own, as it is a heavy body.

2. And conſequently, if Water be conſidered ſeparate from Water, as for the purpoſe when it is put into a Veſſel, as a Pail, Bucket, and hollow Cube, or Globe, the Water and the Veſſel wherein it is making now one body, doth actually gravitate, and hath only one Direction of

of its *motus* or *conatus ad motum*, as other ſolid bodies have, namely perpendicular to the Centre of the Earth, which is the Line and Term of its Motion. So that ſome have by computation eſtimated that a Cubique Foot of Water weighs about 65 Pound; for here the Water is not conſidered as a fluid Element, but is reduced into the nature of a ſolid heavy body, by the Veſſel wherein it is contained and included, which together with it makes up one body, and conſequently governed by the rules of Gravitation incident to ſolid bodies, *viz.* to deſcend perpendicularly. Therefore what I am now to treat of is touching the gravitation of Water, as it is in its own conſiſtency a fluid body; and herein farther theſe things are to be admitted:

1. That the gravitation of the fluid water is all one, whether it be

in the great veſſel of the Sea or Ocean, or in any other artificial and ſmaller veſſel, as a Tub, Trough, or Ciſtern, I mean as to the main queſtion; though there may be ſome various accidental differences in reſpect of the ſtrength, weight, or conſiſtence of the waters themſelves; therefore the ſame reaſon will be of the Gravitation or Non-gravitation of Water upon a ſubjected body, whether it be in the Sea or in a Tub.

2. That without all queſtion, when Water hath its paſſage out of a Veſſel upon or through a lighter *medium* than it ſelf, it doth actually gravitate; as if a hole be made in the bottome of a Tub, it doth gravitate upon that hole.

I ſhall not in this place diſpute, whether Water in its fluid conſiſtency hath not ſome degree of gravitation, for it hath been experimented

mented by many, that a Tube of Quickſilver inverted into a veſſel of reſtagnant Quickſilver immerſed into Water, hath ſome Indication of the gravitation of Water, by the aſcending of the Quickſilver into the Tube, the deeper it is immerſed in the water: and there may be reaſon for it, 1. In reſpect of the interſperſions in the water of divers terreſtrial Particles, or *granula arenæ*, that are in their own nature heavier than the water; which is viſible to the Eye in great Rivers, and much more in the Sea. 2. There may poſſibly be ſuppoſed a ſmall Cap or Cone of water, that may be impendent upon the ſubjected body, that may indure ſome inconſiderable and ſcarce perceptible gravitation. [*Vide quæ dicta ſunt in fine Capitis 9.*]

But that this gravitation is in any degree proportionable to the

column of Water, impending upon the ſubjected body, with a baſe anſwerable to it; or indeed that it is any conſiderable preſſure in the hundredth degree of ſuch a proportion, is moſt certainly untrue.

And if I ſhould call hereunto the atteſtation of divers, the Experiment of the Tadpoles and Fiſhes, as well ſwimming in a great Profundity of water as in a ſmall, nay in a veſſel of water compreſs'd as much as poſſibly may be with a Rammer; theſe and infinite Inſtances more would make it beyond contradiction, that ſuch preſſure or gravitation is not at all conſiderable, though ſome it may be.

And now my buſineſs is to examine the reaſon of this *Phænomenon*, namely why the water in the Sea or in a Bucket doth not gravitate in proportion anſwerable to its intrinſick Gravity, or in pro-

por-

portion to a column of water, proportioned in baſe to the bredth of the ſubjected body.

CHAP. VI.

Concerning the Reaſons aſſigned by others for the Non-gravitation of fluid Water upon ſubjected Bodies.

THough ſome contend for ſome gravitation of water, yet it is certain, that fluid water doth not gravitate upon ſubjected bodies in that prodigious proportion of weight, that a column of water commenſurate in baſe to the ſubjected bodies, and extending from them to the *ſuperficies* of the water,; for if it ſhould, it muſt cruſh the ſubjected bodies to pieces,

or

or at leaſt wholly ſuſpend their motion, for ſuch a column of water, ten or twelve Fathom deep, impending upon a Diver, would amount to ſome Tuns of Water, which if ſeparated in a veſſel, would cruſh all his bones. But the Reaſons that Learned men have aſſigned for this matter, as they differ among themſelves, ſo they are in themſelves very inevident and unſatisfactory, which, as near as I apprehend them, are much of what follows.

Stevinus gives this reaſon, that the preſſure of water is equal every way, upward, downward, and laterally, and therefore the body of a man being thus equally compreſſed every way by the circumjacent water, hath his continuity preſerved, and is not cruſhed by the impending weight of water, neither feels it, but is kept in an equal ſtate and *Æquilibrium*.

But

But the truth is, this leaves the difficulty equal, if not worſe than before; for an equal preſſure of every ſide would cruſh his bowels, and breſt, and ribs into an intolerable condition, and yet leave him to the ſeverity of the perpendicular weight nevertheleſs.

Des Cartes gives this obſcure and ſcarce intelligible Reaſon of it, which, as near as I apprehend him, is thus; Becauſe when the man ſinks into the water, as he deſcends, the ſubjacent water takes the room that his body left. But this ſalves not the difficulty of the Non-gravitation of the column of water, when once got above him.

Merſenius ſalves it, as he thinks, by the Doctrine of *Archimedes*, *de inſidentibus humido*, namely that any given portion of water ſuffers no weight by the ſuperior portion of water, becauſe they are all of one

equal Gravity, and therefore every part of water ſits quiet in any *ſitus* given, without Gravitation or being gravitated by any portion of it ſelf.

And that Bodies heavier than water, (as the body of man is) loſeth ſo much of their natural weight, when in the water, by the weight of ſuch a quantity of water, as is commenſurate to the bulk of that heavier body; ſo that it hath no more than what it exceeds the weight of the like quantity of water. As if the body of a man weighs 200 Pound, and the like quantity of water would weigh 150 Pound, the body of a man would weigh in water but 50 Pound, and upon this account a Diver might eaſily emerge out of the water, for he carries with him but 50 Pound weight; and the intermediate water not being gravitated by the

por-

portion of water above it, doth not conſequently gravitate upon the man, unleſs ſome accident intervene, as where the body of the man ſtops a Leak or a Hole in that veſſel wherein he is.

But this, though it aſſert the thing, namely that Water gravitates not upon Water, or upon any body of an intrinſick Gravity equal to Water, yet it leaves us in the dark, touching the reaſon of the Non-gravitation of Water upon the ſubjacent Water, or any body of an equal intrinſick Gravity with it; ſince he ſeems to agree, that the whole Water gravitates upon the Fund or *baſis* of the Veſſel, for ſome have thought it impoſſible that the whole body of the water ſhould gravitate upon the *baſis*, unleſs every part gravitate upon what is intermediate between it and the *baſis*. Though by the way this is not conſe-

ſequential, for a piece of Lead of a Pound weight doth actually gravitate upon the Scale, and yet the upper part of that piece of Lead doth not gravitate upon the ſubjacent parts thereof, ſo long as they are one continued body; and ſo it may be, and probably is in fluid bodies, while they have their continuity; for a Bucket of water is as much one continued body, as a Bucket of Pitch or Wax, till it be actually divided; but of this hereafter.

A later Author, not content with theſe Explications, hath ſuppoſed a middle intelligent nature between Almighty God, and Matter, or Bodies, which he calls *principium hylarchicum*, under whoſe regiment thoſe various appearances of Nature are managed, of which we cannot find any ready ſufficient natural Solution. And although the end of this learned Author

thor be good, namely to convince Atheiſts, and ſuch as deny the Exiſtence of ſeparate or Spiritual Intelligences, yet me thinks the *medium*, at leaſt as to the particular in hand, is not ſo ſuitable. The moſt important and ſureſt Truths in the world never receive ſo much detriment by the Arguments and Sophiſtry of Opponents, as they do by thoſe Arguments in their favour which have improper *mediums* to ſupport their Concluſions, or ſuch as are capable of other Solutions.

Moſt certainly the Ever-glorious and moſt Wiſe God is the Author of Nature, and of all the Laws thereof; they are his Inſtitutions by which he orders and regulates the Motions and Appearances in Nature. And he ſupports them as an Univerſal Cauſe, by the conſtant influence of his Power and Goodneſs; and all their Appearances are ne-

nevertheleſs ordinarily regular according to hisinſtituted Laws of Nature. And as it far more advanceth the honour and skill of an excellent Artiſt, that hath ſo framed and ordered an *Automaton*, that it may be regularly guided to its end, according to the deſign of the Artiſt, without the immediate hand or identifical act of the Artiſt to guide every motion: ſo it far more advanceth the glory of the Divine Wiſdom, in that he hath ſetled ſuch a regular order in things of Nature, that may regularly conduct them to their deſigned end; then if the Glorious God, or any intelligent Power by him ſubſtituted, ſhould by immediate and identical interpoſition produce every *Phænomenon* in Nature, ſaving nevertheleſs to him his Power and Pleaſure *pro arbitrio*, and upon ſuch occaſions as he thinks fit to interpoſe

poſe his own immediate power, either by the determination of his own will immediately, or by the miniſtration of Angels or Intelligences, to advance, correct, or alter his ſtanding Laws in particular caſes and emergencies.

But yet farther, it ſeems to me that the particular inſtance of the Non-gravitation of water deſerves no more a recourſe to an Hylarchical Agent, than the Inſtance above given of the Non-gravitation of a heap of Sand, or Corn, or Shot; for I think the Solution of one and the other are rational, and much of the ſame kind, as to the Mechanical part hereof.

But yet farther, a very Late and Excellent man hath endeavoured to give a Solution of this *phænomenon*, which ſeems leſs ſatisfactory than any of the reſt; for when he hath abundantly demonſtrated by his

his exact Experiments that Animals do not ſuffer ſo great a preſſure by the incumbent column of water, that doth conſiderably if at all impede their Animal motion, he attributes it to the Frame and Texture of their Bodies, the ordering of their Bones, Muſcles, and other parts; and this I confeſs gratifieth the preconceived *hypotheſis* of the Gravitation of the ſuppoſed column of water, (as likewiſe of that of Air, in the Solution of the *Torricellian* Experiment.) But it ſeems to me, that this Solution favours more of a Miracle than the former ſuppoſition of the Hylarchical Principle: that a Flownder ſhould at Land be preſſed to death by the weight of a gallon of water in a Bucket laid upon him; and yet ſhould not be damnified by the weight of two, or three, or ten Tun of water in the bottom of the Sea,

yet

yet he ſuſtains it without detriment or impediment of his life or agil motion: which I ſay were miraculous, if thoſe Tuns of water did actually gravitate in that meaſure. Therefore I think there had need be ſome other Solutions than thoſe thought upon, if we can hit upon them.

CHAP.

CHAP. VII.

Concerning the moſt probable ſolution of the Phænomenon of the Non-Gravitation of Water in its fluid conſiſtence.

IN matters controverted, though it be more eaſie to find faults with the ſuppoſitions of others, than to ſubſtitute ſuch in their room as may be leſs capable of Exception; yet it is but juſt that (if it be poſſible) for every one that excepts againſt anothers ſuppoſition, ſhould exhibit one of his own, that ſo he may run the ſame tryal with others, as others have done with him. And therefore in the former Chapter having (as near as I can underſtand them) propounded the ſo-

Solutions of other men, and laid them by, as ſeeming to me either inevident, or not giving a reaſonable account of the Probleme, I ſhall now exhibit my own Conjecture of the Reaſon of this Appearance in Nature, wiſhing it no better ſucceſs with others, than it deſerves.

I have before premiſed, that 1. this queſtion muſt not be underſtood of a veſſel of water, as the *continens* and *res contenta* make but one common Body, for ſo it is but in nature of a ſolid and not of a fluid body, and there is in that reſpect no more conſideration to be had of its fluidity, than if the water in the veſſel had been congeled into a whole Kegg of Ice; for the Kegg of Ice and the Water in the Bucket, together with the Bucket containing it; or the Water in the Bladder, together with the Bladder containing it, deſcend by one

ſimple line of Gravitation, perpendicularly from its centre of Gravity towards the centre of the Earth: but the queſtion is touching the gravitation of the water in its fluid conſiſtence, though contained in the Ocean, or in a Tub or Bucket. 2. That I do not in this place contend againſt all Gravitation of water, for poſſibly there may be ſome little allowed it, as unto Air, and eſpecially by reaſon of the interſperſions in the water (as likewiſe in the Air) of ſome ſmall Atomes or Particles of terreſtrial Matter, which may be heterogeneous to the nature of water as ſuch, and as thoſe Particles are in their gravity heavier than water, ſo they may accidentally cauſe a greater gravitation in the Particles of ſome water more than of other, as hath been before ſaid.

But that which I contend for in this

this place, is first, that the gravitation of water in its fluid consistency, whether in the Sea or in a Bucket, if any at all, yet is so inconsiderable, that it doth not considerably press upon subjected bodies, nor incommodate Animals that live therein at any profundity, and not in the thousandth part in actual gravitation proportionable to the weight of a Column of water commensurate in base to the subjected body, and extending from the same to the *superficies* of the water. Secondly, to assign some reason of such Non-gravitation, and why it is not, no nor indeed can be.

The former of these is in effect confessed by all impartial Writers, and evident to every days experience. The latter therefore, namely the reason thereof, are the subject of this Chapters inquiry.

And I think the reasons of this

Non-gravitation of the Particles of water upon ſuch ſubjected bodies, are eſpecially two. The firſt is Mechanical, from the ſtructure of the fluid water; and the ſecond is meerly natural, from the nature of Fluids. Touching the former of theſe, the Mechanical Solution of this Problem, this hath been in effect given before, in the Non-gravitation of the parts of ſolid bodies while in Continuity, which it is plain though they all together gravitate upon the Scale, yet one part doth not gravitate upon another: And water, though a fluid body, yet hath its continuity, which is undivided, and ſo gravitates not upon its own parts, nor upon any body within it of equal or greater weight than it ſelf. But 2. admit, that water, in reſpect of its fluidity, ſhould moſt participate of the nature

ture or reaſon of ſolute and ſeparable bodies, that are only contiguous; yet even in thoſe ſolute bodies, as Sand, Granes, Shot, every Monad of ſuch ſolute bodies gives ſupport to the ſuperjacent Particles, though not united into one *continuum*, as in the inſtances of a Pyramid of ſquare Stones, a heap of Wheat, or of *Callice* Sand; wherein a kind of Arch is made over the ſubjected bodies, that they by no means ſuſtain the whole weight of the incumbent column, proportionate to the baſe of the body included.

But in caſe of the body of water, the ſame advantage is infinitely more improveable for the eaſe and ſecurity of the ſubjacent bodies, whether animate or not. For although I ſhall not take advantage of the imaginary configuration of the Particles of water invented by *des Cartes*, who ſuppoſeth them to

be like ſmall oblong filaments or fibres, not much unlike little Grigs or Eels, which would eaſily make a conſiſtency, that like an Arch would protect and cover the ſubjacent body. Nevertheleſs I ſhall ſay this, that the union of its parts are much cloſer than that of the Monads of *Callice* ſand, for the water is *quid continuum*, though *fluidum*; & therefore as the parts of one continued ſolid body do not gravitate upon the other parts, but only upon the common baſe of the whole body; ſo the parts of water do not gravitate upon themſelves, nor upon any particular baſe leſs than their own baſe, but one part ſuſtains the other without any gravitation: as the Arch of a well framed Vault, doth not preſs upon the ſubjected Vault, but each part is ſuſtained by the other, and the whole by thoſe walls from whence the

the Ribs of the Arch are drawn. A very little induſtrious trial of the ſuſpenſion of Sand in a Tube framed for that purpoſe, will make the Inſtance more intelligible, than words or writing can do it.

It may poſſibly be true, that a more broad body, heavier than ſo much quantity of water, may have a greater gravitation of water upon it than a narrower, becauſe the arch that is made over it by the water, is greater than that Arch that is made over the narrower body. For inſtance, let us ſuppoſe that in the bottom of a Bucket of water, three foot deep, and one foot in the circumference, there be placed an Ebony rundle, of one Inch thick, and eight Inches Diameter; and in the bottom of the like Bucket there be placed a rundle of Ebony of four Inches Diameter, and of ſuch a thickneſs as may make the

weight of it equal to the weight of the greater rundle, as in the ſubjected Figures.

I ſay it may fall out, that the water may more gravitate upon the greater Rundle, than upon the leſſer, becauſe that ſmall Cone of water that is incumbent upon the greater, which hath the larger baſe, makes a larger Conical body of water upon that which hath the larger *baſis*, than that which hath the narrower. This may be eaſily tried by a pair of Scales, induſtriouſly ordered for ſuch an Experiment. But however that fall out, it is moſt evident, that the whole weight of the column of water, commenſurate to the baſe of either Rundle, and

and extending it ſelf to the *ſuperficies* of the water, doth not in its full weight gravitate upon either, unleſs we ſuppoſe a hole in the bottom of the Veſſel under either Rundle, and then indeed the water will gravitate upon the Rundle, becauſe it gravitates upon the hole.

But if the ſubjected body be lighter than the like quantity of water, commenſurable to its bulk, then it is true the water will undermine that lighter body, and carry it to the *ſuperficies*, notwithſtanding the ſuperimpendent Cone or Column of water: but this is not to my preſent purpoſe to explicate, and therefore I leave it.

CHAP.

CHAP. VIII.

The ſecond and principle Reaſon of the Non-gravitation of Water upon it ſelf, or a ſubjected Animal, or other body.

I Come now to the ſecond principal Reaſon of this Non-gravitation of Water, either upon its inferiour parts, or upon any ſubjected Animal or Body, either heavier or equal in weight to the like bulk of Water; for if it be lighter, it will ſwim, as hath been ſaid. And this I take to be the true natural ſpecifical Reaſon of the Non-gravitation of Fluids; though the former, namely the Mechanical Reaſon before given is not wholly uſeleſs, but contributes its part to it.

And

And here I muſt premiſe what I before ſaid of that actual gravitation, *viz.* that it is either Motion, or *conatus* or *niſus ad motum.*

And therefore let the body be never ſo intrinſecally heavy, yet if even by accident (much more if by the natural conſiſtency thereof) that *niſus* or *conatus* be ſuſpended or corrected, the Gravitation abateth. For inſtance, it is moſt certain that the body of the Earth is intrinſecally heavy, and the heavieſt of all Elements that we know of; yet whether we ſuppoſe it to be the Centre of the World, or that the Sun is that Centre, and the Earth in its *magnus Orbis* moves about it, yet it hath no Gravitation to incline it to change its place, or its circular motion; and the reaſon is, becauſe it hath no *niſus* or *conatus* to any other poſition or place then what it hath.

Again

Again, in matters artificial it is plain, that a Pound of Lead hath its natural motion by a perpendicular direction and line to the centre of the Earth; and this is the true cause of its Gravitation upon my Hand, namely its *nisus ad motum*; and as any body hath the greater *nisus* or *conatus* than another, so it hath the greater actual Gravitation, as Gold more than Quicksilver, that than Lead, that than Tin, quantity for quantity.

But if I take a pair of Scales, and in one Scale put a pound of Lead, and in another half a Pound, I check and abate its *conatus*, and consequently its gravitation, and it hath but half the vigor of gravitation as it had before; and if I counterpoise it in the other Scale with a full equal weight, I suspend totally its gravitation, and it shall ascend or descend with a small advantage of

a

a grane added to the oppoſite Scale, or to this, and ſtill the reaſon is the ſame, the *niſus*, or *conatus ad motum*, and conſequently the actual gravitation depending upon it, is checked by the Counter-motion of the oppoſite Scale. That therefore which I muſt perform in the application of this Reaſon, conſiſts of theſe Parts or Propoſitions.

1. The firſt Propoſition, which is this; That which hath ſeveral Directions or Lines of its *conatus ad motum*, muſt needs have ſeveral Directions of its Gravitation.

2. That body which hath ſeveral lines or directions of its Gravitation variouſly directed, cannot entirely gravitate in one line, or by one direction.

3. That which doth not gravitate by one line or direction, but variouſly, it muſt neceſſarily follow, that every tendency, line, or direction

ction of its gravitation doth correct and refract the force of its other gravitations according to its other tendencies and directions.

4. That Fluids, and particularly that of Water and Air, have several lines of its direction of gravitation, and therefore necessarily one must be refracted, impeded, and abated by the other.

5. And consequently, the direction of its perpendicular or lateral gravitation are corrected, and very neer wholly suspended by the other tendencies or directions of its motion. And although in order of reasoning I should begin with the more general Propositions; yet because they will be the best evidenced by beginning with the enquiry into the various directions of the motion, *conatus* and *nisus* of Fluids, I shall invert the order of that Ratiocination, and begin at the latter

end,

end, namely the various Directions of the *conatus* or *niſus ad motum* of Fluids.

That there is a motion, and *conatus ad motum* in water, as a heavy body, in a perpendicular line of direction toward the centre, all do agree, and it need not be queſtioned, for it ſeems it is the primitive *conatus* of this as of all heavy bodies, and is an effect of its intrinſick gravity. But beſides this primitive motion as a heavy Body, it hath divers other motions and directions as a fluid body, and thoſe naturally belonging to it in that conſiſtency. For inſtance,

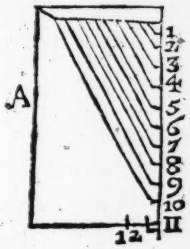
1. It hath within the compaſs of its own *ſuperficies* a lateral motion parallel to the Horizon: which appears by the immerſing of a Tube ſhut at both ends, and placed horizontally below the *ſuperficies* of the water, and then ſuddenly un-

unſtopping one end, the water will as nimbly move into that Tube, as if it ſtood perpendicular to the Horizon.

2. Again, within the compaſs of its own *ſuperficies* it hath a motion, and conſequently a *conatus ad motum*, and conſequently a gravitation directly vertical; as if a Tube ſtopt at the lower end, and immerſed into the water, and then the lower end artificially unſtopped, the water will ariſe in that Tube to the level of the *ſuperficies* of the ſtagnant water, and drive out the Air that was in it before.

3. Again, it is certain, that the water in any veſſel hath *conatus ad motum per declive*, in all points between a line parallel to the Horizon, and the line of its perpendicular gravitation, according to this rude Diagram in the veſſel of water *A*.

And



And although for deſcriptions ſake I make theſe lines of direction *per declive*, to be from the centre of the *ſuperficies* of the water, yet I think it improper, and indeed impoſſible to ſhew or define, from what point of the water this *conatus ad motum per declive* begins. Nay farther, it ſeems evident, that water being a *homogeneal* body, every aſſignable Particle of water hath this direction of *deſcenſus per declive*, as all other directions incident to its fluid nature, as well as the o-

ther motions or *conatus* above ſpecified.

And that the water hath theſe lateral preſſures, and *conatus ad motum per declive*, is evident to ſenſe; for, take a Barrel ſet upon his baſe, and fill'd with water or any other liquor, it will with almoſt an equal force gravitate upon the ſides of the veſſel, as well as upon the fund or baſe, and break out the ſides if it be not well guarded with Hoops or other ſtrictures.

Now to apply this poſition to the former Propoſitions, I ſay this various motion and *conatus ad motum* of Fluids, cauſeth ſeveral kinds and *ſpecies* of lines and directions of their Gravitation, ſome directly deſcending, ſome directly aſcending, ſome Horizontally lateral, ſome *per declive*, or medial between a line parallel to the Horizon, and perpendicular thereunto.

And

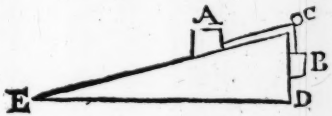
And consequently in the very same fluid body every different direction (whether lateral *per declive*, or perpendicular) of its Gravitation is corrected, abated, and refracted by the other; and it is impossible it should have its full swinge of motion any one way, or by any one line, since it hath its considerable motion or *conatus ad motum*, the same moment by another line, either contrary or extremely different from the other, *omnibus intentus minor est ad singula*. And consequently the gravitation of Fluids, whether lateral, or perpendicular, or *per declive, sive per modum lineæ subtensæ*, is abated, corrected, and refracted, by the various lines of its tendency: for it is impossible that the same body can at the same time with its full swinge be carried to any one point, which at the same time hath very

neer an equal *conatus ad motum* to a various point, and by a various line of Direction; or that that Fluid ſhould *totis viribus* be directed in its motion or *conatus* thereunto towards the centre, which at the ſame time is directed laterally, or towards the North in its lateral motion, or *motus per declive*, which at the ſame time hath a direction or tendency towards the South-Eaſt or Weſt, or any other point of the Compaſs, either laterally or *per declive*.

It is true, that poſſibly that kind of line of Direction in a perpendicular deſcent may be conſiderably ſtronger and more efficacious, and conſequently the gravitation that way ſtronger than in any one other line of direction of its gravitation, becauſe there contributes to that motion, not only the nature of Water as a fluid body, but alſo as a heavy

heavy body, which always taketh the ſhorteſt line of direction to the centre, which is the perpendicular.

And hence it is, that if there be an Engine conſiſting of a Baſe parallel to the Horizon, and a perpendicular upon that Baſe, and a Subtenſe or decline *ſuperficies* from that perpendicular to the Horizon, as in the ſubjected Figure.



The weight *A* upon the Subtenſe doth counterpoiſe to the weight *B* in a reverſed proportion, anſwerable to the length of the lines *C E* and *C D*. So that if the perpendicular *C D* be half the length of the Subtenſe *c E*, the ſame weight upon

upon the line *CD* gravitates double to the ſame weight *A*, upon the line *CE*: becauſe it hath the moſt expedite and ſhort way to the centre by the perpendicular *CD*; and the other by *CE* is longer, and refracted, and broken by the inclination and diſtance *CE*. But on the other ſide, if the line of perpendicular deſcent of the Fluid be compared with all thoſe various and many lines of its other direction, when the centre at leaſt hath any conſiderable depth, the perpendicular motion of its gravitation as a heavy body, is either altogether or very neer altogether corrected, abated, and refracted by its other motions or *conatus ad motum*, or gravitation as a fluid body, ſince there are as many or more other *ſpecies* of lines directing its *conatus ad motum* in other lines, as there are of its perpendicular deſcent.

And

And *è converſo*, all the ſeveral lateral lines, or lines of Declivity of its tendency *ad motum* are ſo far corrected and refracted by its perpendicular, and other *conatus ad motum*, that they are as in the former inſtance of the two equiponderating Ballances, rendred in a manner *in æquilibrio*, and all of its ſeveral lines of Gravitation and tendencies thereunto, are in a very great degree ſuſpended and refracted one by another.

And ſurely this conſequence is abundantly evidenced by the inſtances before given, *Chap.* 4. in the Column of *Callice* Sand: which is much more confirmed in water. For the Monads of *Callice* Sand are actually divided one from another, but the Particles of water are conjoined in one *Continuum*: the motion of *Callice* Sand *per declive* is not ſimply natural, but aceidental in

reſpect of the poſition of thoſe parts upon which it falls, which becauſe they one hinder another from the next and ſhorteſt way to the centre of their motion, by a ſtraight line, therefore move *per declive* as well as they may. But Fluids have all thoſe varieties of tendencies incident to their nature; yet it is apparent beyond all contradiction, that this accidental tendency of the motion of Sands *per declive*, doth break the perpendicular gravitation, and makes it not to gravitate upon the moſt fragile ſubjected body in its full weight.

But I ſhall yet farther adventure to add one farther Explication and Enforcement of this Suppoſition: it is aſſerted by ſome, that a Foot ſquare or Cubique Foot of water, weighs about 65 pounds, which I have not Experimented, and therefore cannot aſſert;

But

But I will ſuppoſe (as making beſt for the Explication of what I intend) it weighs but twelve pound, and this is the entire perpendicular weight of this portion of water; for *ex ſuppoſito* it weighs no more, being put into a Bucket, & weighed in a pair of Scales, with due allowance for the weight of the veſſel; and it is impoſſible it ſhould be more in the whole than the weight ſuppoſed.

But it is apparent, that the direction of this weight of twelve Pound, allowed to the water while it is in the Bucket, is not only perpendicular upon the Baſe, but laterally upon the Sides of the veſſel that contains it: and every ſide of this Cube of water hath as many kinds for its Direction of deſcent lateral or *per declive*, as the Baſe hath for its perpendicular deſcent.

And yet here is but entirely one twelve

twelve Pound weight of water, that muſt ſerve as the common ſtock of all its Preſſures, *viz.* lateral *per declive*, or perpendicular, and muſt be diſtributed to all theſe lines as water from one common Ciſtern, through ſo many Pipes to ſerve all theſe Gravitations, or *conatus ad motum*; for it hath not in all above twelve Pound weight to ſerve all theſe *conatus* or Gravitations.

The conſequence whereof is of neceſſity, that this common ſtock of intrinſick weight of twelve pound, belonging to all this portion of water, is neither intirely allowed as the ſupply or portion of the perpendicular weight or gravitation, nor entirely allowed to the lateral gravitation, or the *niſus ad motum per declive*, nor to any one kind of Line of either of theſe *conatus*; but is indifferently, or very neer

in-

indifferently communicated to every line of its *conatus ad motum*, whether lineally deſcending, or collaterally, or *per declive*, and the common portion of twelve Pound weight is very neer equally divided to every line of Direction in the water, which are as many as there be diviſible parts in the lateral or ſubjectedbaſe of the veſſel of water.

And by this diſtribution it muſt needs fall out, that the weight of twelve Pound of water is infinitely diſtributed according to various direction, and no one line can pretend to the entire gravitation of that twelve pound of water, no nor to the thouſandth part thereof, conſidering its various diſtribution.

And now if any one ſhall ask, if the water in the Bucket hath not one entire gravitation towards the Centre in the perpendicular Line, but

but hath its weight thus distributed to several lines of direction; how it comes to pass that the whole Bucket of water weighs perpendicularly twelve Pound, and that weight is not broken by the lateral pressure of the water.

The Answer is plain, and hath been sufficiently insinuated before.

The water in the Bucket is as fluid a body as so much water in the Ocean, and hath the same kind of motion, and *conatus ad motum*, as well collaterally as by direct descent, as is incident to its nature, though it receive an obstruction in that motion, by the strong sides and contignation of the Bucket. But the Bucket of water is now become as one solid body, and gravitates according to a solid body, *viz. per lineam descensionis*, and not as a Fluid *quoquo versum*: and though the fluid water within the Bucket

preſs upon all parts of the Bucket, according to its natural and various tendency, yet it goes no farther, nor do the ſides of the Bucket preſs upon the ambient Air, or *medium*, being ſufficiently ſecured by its ſtrength and firmneſs, and not yeilding to the *conatus* or *niſus* of the included water.

Many other Inſtances and Experiments might be added for the evincing of the truth of this Suppoſition, but if I make my ſelf intelligible to the Reader, theſe are ſufficient to explicate what I mean, and his own obſervation will furniſh him with Experiments either to confute, or to confirm what I have ſaid.

And thus far touching the non-gravitation of Water, & the reaſon thereof; which may be (as I think) applicable to all other fluid bodies, as Oyl, yea Quick-ſilver it ſelf,

ſelf, at leaſt in a great degree, and by analogy of Reaſon, though I have not had opportunity to Experiment it.

CHAP. IX.

Certain Conſequences or Conſectaries, drawn from what hath been before ſaid.

FRom what hath been before expreſſed in the two former Chapters, theſe things ſeem naturally to follow.

1. That the upper parts of a fluid body doth not gravitate upon the lower parts of that fluid body.

2. That if any body of equal weight with the Fluid be within the extent of the fluid body, the fluid body doth not gravitate upon it, nor it upon the ſubjected fluid body,

dy, but every part holds its ſtation.

3. That a fluid body contained within a ſolid veſſel, doth not with its full weight gravitate upon the baſe of that veſſel that contains it, as the whole body of the Sea, or of the water in a Bucket, doth not gravitate with its full weight upon the entire baſe that ſuſtains it; and this is in reſpect of the natural conſiſtency and frame of Fluids, not purely upon the account of Mechanical Suſtentation, which muſt be agreed ſomewhere to gravitate, though not upon all parts, as hath been ſhewn.

4. Though it were granted that the entire bulk and weight of the water in the Sea or a Veſſel might gravitate upon the entire baſe, (which yet is not admitted) yet the parallel parts of water do not entirely gravitate upon a part pro-

proportionable to them. For instance, ſuppoſe a Cube of water in a veſſel of nine Inches ſquare; if we ſhould ſuppoſe the whole Cube ſhould gravitate upon the baſe, yet the column of three Inches ſquare in the middle of the Cube would not gravitate upon three Inches ſquare in the middle of the baſe of the Cube, even for the Mechanical reaſon above given.

5. That conſequently, no body heavier than water in the baſe or Fund, doth ſuſtain a weight of water proportionable to ſuch a column of water as is in the baſe and top, commenſurate to the amplitude of the body in the fund or bottom.

I ſhall add this unpoliſhed Experiment for the concluſion of this *Chap.* namely, I made an Experiment touching the weight of a piece of Lead, in ſeveral depths of water;

I cannot build much upon it, becauſe my opportunities for it were not exact, nor ſuch as others may have, yet I ſhall offer it: others may make, or poſſibly have made it with more exactneſs.

I took a flat round Cake of Lead, of four Inches Diameter, and making four holes in the four quarters of it, I ſuſpended it parallel to the Horizon upon a Packthrid of five Foot long, and hanged it to the end of a ballance like the Diſh or Scale, and counterpoiſed the Lead and Packthrid by a weight impoſed in the other Scale, the Lead and Packthrid *in arido* weighed ten Ounces, and as much as the Diſh wherein the ten ounces were placed, which poſſibly might be about two ounces more, in all about 12 Ounces.

In a veſſel above four Foot deep in water, I immerſed the Lead four

Foot deep in water, and then (as it needs muſt by the groſsneſs of the *medium*) it loſt part of its gravitation, and weighed only eight Ounces $\frac{1}{2}$ $\frac{1}{4}$, beſides the weight of the oppoſite Scale. Then taking up the ſtring ſhorter, I immerſed it only in a Foot depth of water, but yet it gain'd no more weight that I could perceive, but weighed as before one Ounce $\frac{1}{2}$ $\frac{1}{4}$.

But indeed immerſing it onely in one Inch of water below the *ſuperficies*, it increaſed its weight near $\frac{1}{8}$ of of an Ounce, for the Lead weighed one Ounce $\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{8}$ of an Ounce, or very near thereabouts, beſides the weight of the oppoſite Scale or Diſh.

By this rude Experiment it ſeems the Column of four Foot of water, gravitated no more than one Foot of water; or if it had any acceſſion of weight, it was not perceptible, yet

yet (according to *Stevinus* calculation, in his 4*th* book of his Hydroſtaticks, (which yet I do not altogether allow) that a Cubique Foot of water weighs 65 Pound,) the proportion of the Column of 4 foot amounts to about 567 ſquare Inches, which is about 8 pound; but the Column of one Foot is but 144 Inches, which is but about two pound weight of water. I do not trouble my ſelf with curioſity in calculation; but it ſufficeth, to give ſome account of the Imperceptibleneſs, or at leaſt Inconſiderableneſs of the difference of the gravitations of Water in various Depths.

CHAP. X.

Concerning the gravitation of the Air.

I Do not intend here to make any large diſcourſe upon this point,

becauſe indeed it deſerves a larger Examination than this portion of Paper that remains will afford, to unrivet that Opinion touching the Gravitation of free Air, with which many have pleaſed themſelves, and thereby indeavoured to reduce the ſolutions of Problems and Appearances in Nature, but are therein as I think deceived.

That the Air may have Gravitation, it being ſecluded from the ambient Air by a Veſſel (as well as Water) as in a Bladder, none that I know do much deny.

That the interſperſions in the Air of *halitus terreſtres*, *& vapores aquoſi*, may have and hath ſome Gravitation, more than what belongs to pure Air, I ſhall not queſtion. But that the Air, yea or Atmoſphere hath that prodigious gravitation, that the late Maſters of Experiments have attributed to it,

is

is I ſuppoſe a miſtaken Aſſerti[illegible]. As, for inſtance, that upon a reſt[illegible]nant veſſel of three Inches dia[illegible]ter, the weight of the incum[illegible] column of Air, actually gravitat[illegible] upon that reſtagnant veſſel of Quick-ſilver, and commenſurate to the baſe thereof, and extending from the ſame to the upper ſurface of the Atmoſphere, which they ſuppoſe to be 6 or 7 Miles) ſhou[illegible] counterpoiſe a ſuſpended column of Quick-ſilver, which may be 2, 3, 4, or 5 Pounds, according to the bigneſs of the Tube. This they, ſeems to me but an Imagination, and impoſſible to be true, and would choak all Animals on the Earth in two minutes, if it were ſo.

For the plain truth is, the Air, no nor yet the Atmoſphere, notwithſtanding its interſpherſions, hath no conſiderable gravitation upon ſubjected bodies. And the reaſon

reaſon is in effect before given, in the caſe of the water, and its gravitation, but with much greater advantage applicable to the Air.

1. The body of the Air is not only *quid continuum*, but the parts of it are ſo contiguated, like a Net, that each part ſupports another; and its as impoſſible that one part ſhould gravitate conſiderably upon any ſubjected body, as the Arch of *Weſtminſter* Abby ſhould gravitate upon the people in the Church.

2. The *conatus ad motum*, and conſequently the gravitation of the Air is *quoquo verſum*, viz. *ſurſum, deorſum, dextrorſum, ſiniſtrorſum, &c.* it will come down my chimney, and in at my door, and up my ſtairs, and theſe various *conatus ad motum* of the Air and of its Particles, do neceſſarily refract any gravitation that it may imaginably have *per lineam perpendicularem deſcenſus*, and renders

renders it *equable* and disingaged from any one line of presence.

And by this *conatus ad motum*, I mean not that Imaginary *Elaterium* which some have called in to the Aid of their solution of the *Torricellian* Experiment, which I must needs say needs more help than one: for though Air violently compres'd, as in Wind-guns, hath its *conatus* of restitution to its natural staple, and being expanded by Rarifaction, hath its natural motion or *conatus* of restitution to its due consistency, as appears in the *Torricellian*, and divers other Experiments; yet the great *Elaterium* of the Air in its natural consistence, called in by some to help at a lift, as it hath little evidence, so it contributes less to the solution.

Indeed it hath a Fluidity greater than Water, and therefore is moveable to all places for its reception.

It

It is compreſſible, which water is not; but for any *Elaterium*, or ſuch conſiderable Expanſion of it ſelf, as to offer any force to other bodies, ſeems unwarranted by reaſon or Experience, or common ſenſe, unleſs where by violence or accident compreſſed or expanded beyond its natural ſize.

But I do not at preſent purſue this matter to all its Refuges, it requires more time and Paper, and will exceed the bounds of my intended Pamphlet; and beſides, the Diſcuſſion beforegoing, touching the reaſon of *Non-gravitation of Water*, renders that concerning *Non-gravitation of Air* eaſily intelligible, and applicable to it, with much greater advantage of reaſon and evidence.

FINIS.

Some Occaſional

ADDITIONS

TO THE

PAMPHLET

Called the

ESSAY.

1. WHereas in that Pamphlet, *cap.* 4. *pag.* 21, 22, 23. an inſtance is given, touching a Pile of ſquare Stones, out of which in the middle of the Baſe a parcel is taken out, ſome have thought, that it is therein affirmed,

that the Column commenſurate to that ſubducted Baſe, was not at all ſupported by the middle Baſe, whilſt in Contiguity with the reſt of the pile, this is not at all therein affirmed. Indeed it is ſaid, and ſaid truly, that when that middle part is taken away, the ſuperior Column doth not Gravitate upon the Cavity, and it is plain it doth not, for then that Column would entirely ſink, which yet it doth not; for by that ſubduction the Gravitation is now intirely transferred to the circumjacent parts of the Pile, and is ſupported by it: But while that ſubducted portion of the Pile was in Contiguity with the reſt, it did bear a ſhare of the weight of the impending Column, but moſt certainly did not bear the entire weight of the Column; the words of the Pamphlet, *pag.* 22, are as plain as need to be, *viz.* (*Becauſe*

the

the Column is not MERELY ſupported by the Baſe of 16 Foot, but by the reſidue of the whole Pile.)

2. Whereas in *pag.* 24, there is ſubjoined the Inſtances of a heap of Wheat or Sand, It is inferred, that the Pamphlet ſuppoſeth, that by Subduction of a part of the Baſe of the Wheat or Sand, the impending Column will not ſubſide: As that is no where ſaid, ſo the very Inſtances that are given touching them, are quite of a different ſuppoſition, *viz.* of an Egg-ſhell, or other weak Body, placed under that Sand or Wheat, which will not be compreſſed thereby by the impending Column, commenſurate in Baſe to that Egg-ſhell: The Inſtances of the Pile of Stones and of the heap of Wheat are both introduced to ſhew an accidental impediment of the Gravitations of a Column of Stones, Wheat, or

 Sands,

Sands, entirely upon a commenſurate Baſe; but the application thereof is different, as it is neceſſary it ſhould, in reſpect of the diſparity of the Stones of a Foot ſquare, and the Exility of the Grains of Wheat or Sand, which would eaſily paſs through a breach in the Baſe, though it would not conſiderably Gravitate upon the weak reſiſtance of an Egg-ſhell.

3. There is not in this whole Pamphlet ſaid, to my remembrance, that Elements are not heavy in their places, though it is in ſome ſenſe true, in ſome ſenſe falſe; neither is it at all ſaid, that lighter Fluids may not, or do not Gravitate upon heavier; neither is there any Sillable that I can find in this whole Book, that doth in the leaſt refer the cauſe of the *Phenomenon* of the *Non Gravitation of Fluids upon ſubjected*

jected Solid Bodies to this cauſe, but leſs principally, to the mechanical cauſe, contained in the ſeventh Chapter, and more principally, to the natural direction of the motion of Fluids, contained in the eighth Chapter, which I there call *The true natural ſpecifical reaſon*: Indeed in many places it is there ſaid, that Fluids do not Gravitate conſiderably upon Bodies of equal or greater weight than themſelves; and it was neceſſary to add that affirmative qualification, for two Reaſons; Firſt, becauſe upon a lighter Body, as the Air, at an Orifice of a Veſſel, the Water will Gravitate. 2. Becauſe, if it be a ſolid Body, and ſpecifically lighter than Water, the Water will be ſo far from Gravitating upon it, that it will impel it up: But it is no where ſaid, that I remember, that a lighter Fluid doth not Gravitate upon a

heavier, but the clean contrary is aſſerted and proved by a diſtinct Chapter, on *The Obſervations upon the Torricellian Experiment*, Chapter third and fourth, though therein that prodigious Gravitation, by ſome aſſigned to the lighter Fluid of the Air, be contended againſt.

I come now to ſome Philoſophical and Mathematical matters of ſome more importance.

1. It is objected, that it croſſeth it ſelf, when it ſayes, the Wheat doth not Gravitate upon the Egg-ſhell, and yet the Air included on the ſhell, being lighter than the Wheat, muſt needs be preſſed upon by the heavier Body of the Wheat or Sand: I anſwer, that part of the Wheat Gravitates upon the Egg-ſhell, but not the entire Column of the Wheat commenſurate in Baſe to the Egg-ſhell, nor enough to break it.

2. The

2. The reſiſtance of the Gravitation of the Wheat, is not by the Air in the Egg-ſhell, for that hath liberty to recede by the open parts in the Baſe of the Egg-ſhell: But the reſiſtance is by the interpoſed ſhell, which is of ſufficient ſtrength to ſupport it ſelf againſt that little preſſure of the portion of the Wheat that preſſeth upon it, though not againſt the weight of the whole Column, if it ſhould entirely Gravitate upon it: And therefore, it is uſed as an argument againſt ſuch a Gravitation of the entire Column of Wheat, which is farther evinced by the Hail-ſhot, and the Column of Sand, though preſſed with another weight of Lead: The true reaſon whereof will be preſently given.

For a Farther improvement of thoſe Inſtances of the Wheat, Sand and Shot, mentioned in that Pam-

phlet, and the discovery of the true reason, therefore I made this trifling Experiment; I took the Acute end of an empty Egg-shell, that was not newly laid, that so the consistence thereof might be the harder by the Air, though more brittle, and pared the limb of it with a pair of Sizers, so that it became a Cone of about an Inch deep, and an Inch and an half broad, in the Base, after the manner of this Figure.

Laying it upon its hollow Base upon a Table, covered with a thin Cloth, I found it would not be crushed by the superimposition of

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a Weight of near 50 Ounces, but the addition of five or ſix Ounces more, cruſhed it flat, ſo that by reaſon of its hardneſs, texture, figure and poſture, it would ſuſtain a greater weight than one would eaſily think, but not above 60 Ounces.

Then I took a Tube of Laten, of the Diameter of four Inches and an half, and about ſeven or eight Inches high, open at both ends.

And placing the like Egg-ſhell upon his Baſe, upon the like Table as before, I built, as well as I could, hard dry white Peaſe round about it, till it was covered, to make it to keep in its ſtation, and then clapt my Tube over it, contiguous to the Table, ſo that the Egg-ſhell ſtood in the middle of the cavity of the Tube, and was invironed conſequently with a circle of about three Inches in breadth every way, now

filled

filled with Peaſe: Then letting down Peaſe by the ſide of the Tube, gently one by one, that they might not by their fall diſorder the poſition of the Egg-ſhell, till the whole ſhell was covered, and then poured them in more liberally, till the Tube was near filled.

Then I placed upon the middle of this Column of Peaſe, a weight with a Baſe, not ſo ample as the Tube, but about two Inches Diameter, that it might preſs the more vigorouſly upon ſo much of the Column of Peaſe as was commenſurate to the Egg-ſhell, and impending upon it.

This weight was no leſs than thirty Pounds of Lead, and lay upon it a quarter of an Hour.

Then taking off the weight of Lead, I gently raiſed the Tube, ſo that the Peaſe gradually ſubſided out of the Tube upon the Table.

And

And when I came to this Egg-ſhell, I found it as firm and ſound, as when it was put in; and this I found true upon ſeveral trials.

Some things I ſhall obſerve upon this ludicrous Experiment.

Firſt, it is certain, that the Air under the ſhell, contributed nothing hereunto, for the Baſe of the ſhell was not ſo cloſe, but that the Air had a vent to diſcharge it ſelf, if preſſed.

Secondly, that in this inſtance, the ſhell is not equally preſſed in all places, for the *interſtitia* between the Peaſe, contiguous to the ſhell, muſt neceſſarily take up above ſix times the ſpace that the contiguities of the Peaſe took up, which being globular, and the ſhell conical, no one Peaſe could preſs but little more than a Phyſical point on the places of its Contiguity.

Thirdly, that the reaſons why the

ſhell is not broken, are apparent and purely mechanical, *viz.* 1. Becauſe the Egg-ſhell ſuſtains but little of the weight above it, but the circumjacent Baſe of two Inches broad, lying round about the ſhell, bears the moſt conſiderable weight, and is, as it were, the principal *Baſis* or Foundation, upon which the whole Pile is built. And although perchance with a vaſt weight, there might be ſome concuſſion, yet the weight above uſed, could not diſorder it, becauſe it muſt make all the Peaſe ſink to a lower poſition on the circumjacent circular Baſe of two Inches breadth, before it could bear with any preſſure upon the Egg-ſhell, which is impoſſible for ſuch a weight as was uſed to effect. 2. Becauſe the Peaſe being circular, and built as it were up from the Baſe and Sides, every Peaſe ſuſtains two, three, or four, or more, and

and thoſe give the like ſupport to thoſe over them; ſo that in truth, the Egg-ſhell, at ſome little aſcending diſtance, is protected by the ſuperimpendent Peaſe, as by an Arch. 3. Becauſe that although the Peaſe being ſolid Bodies, have naturally only a perpendicular motion, yet accidentally, and in reſpect of their figure, ſituation and poſition in the Tube, they have a lateral preſſure upon the ſides of the Tube, which breaks much of their Perpendicular Gravitation, for the ſides of the Tube impede the lateral Expanſion of the Peaſe, and therefore, they bear hard againſt it: And therefore (though I confeſs I have not tryed) I do really think, that if the ſuperimpoſed weight were commenſurate to the Baſe of the Tube, and too great for the ſtrength of the ſides of the Tube, to ſuſtain, as ſuppoſe 100 or 200 pound

pound weight, it would ſooner drive out the ſides of the Tube, towards the top or middle, than towards the bottom, becauſe, like the great end of a Wedge, it would preſs more there, and make it ſpread neareſt to the weight.

Pag. 38. Touching the reaſon of the indolence of divers, given by *Stevinus*, and ſince taken up and inforced by ſome learned men, *viz.* the equal preſſure of the Water, upon the whole body, the reſiſtance of the Muſcles and included Air, *&c.* It ſeems moſt plain, it is neither ſatisfactory, nor ſufficient, no nor at all anſwers the *phenomenon*.

1. Becauſe, though the preſſure of the Water might be equal, yet the reſiſtence of the body is not equal; Indeed if the whole body were of the ſame ſtructure as the Thorax, Shoulders, Ribbs, Skull, *&c.* there might be ſome colour for this Solu-

Solution. But it is quite otherwiſe, the *Abdomen* and Bowels, have not the twentieth part of the reſiſtence of thoſe other parts, but will be cruſhed together or diſordered, and preſſe upon the *diaphragme* with the twentieth part of the weight that thoſe other parts ſuſtain; and yet experience gives us an aſſurance, that there is no preſſure upon thoſe parts, more than the other; for if it were reſpiration would ceaſe by its preſſure upon the *diaphrage*.

2. But again, it is agreed by the Elateriſts, that the Water hath a lateral preſſure, as well as the Air, and without it, the inſtance gave by a Learned hand, of the conſiſtence of a pound of Butter, not altered by the ſuppoſed preſſure of Air, could have no colour of anſwer: And conſequently, when a man is in the Bath, or in a Pond,

up

up to his Neck, there must be, according to what is agreed by the new *Hypotheſis*, a lateral preſſure of Water upon him of a very conſiderable weight, poſſibly the bulk of two, three, or four Tuns, or more, according to the Amplitude of the Water, but his Head, which is not under Water, is not at all preſſed (if they ſay it is preſſed by the Air, if that ſhould be admitted, yet ſo according to the new Doctrin, ſo is the Water alſo) now in what a condition ſhould this mans unpreſſed Head be? all the Humours, and Blood, and Spirits, and *Serum*, that it were poſſibly able to receive, muſt be crouded up into his Head, which would diſorder and ſuddenly kill him; yet no ſuch effect is found, no not in Quick-ſilver it ſelf, wherein an Arm is immerſed, though the reſt of the Body be not immerſed therein. And the reaſon is truly given by the Pamphlet

phlet, *viz.* The Body immerſed in the Water is very little preſſed, either by the lateral or perpendicular preſſure of the Water, becauſe each of thoſe motions or Gravitations, are corrected and abated by the other.

3. But the trivial inſtance before given of the Peaſe, ſhew the untruth of this Solution, for the parts of the Egg-ſhell not preſſed, are ſix times more than the parts of the Egg-ſhell preſſed by the contiguity of the Peaſe, yet no breach of the Shell; therefore ſome better Reaſon of this *Phenomenon* muſt be aſſigned: And the Reaſon holds in Water alſo.

Chap. 7. The mechanical Reaſon therefore of the *Non Gravitation of the Water upon the Body of the Diver*, or other included Body, heavier than the Water, and being narrower than the entire Baſe of the

Veſſel, or Pond of Water (though it be not the principal Reaſon or Solution relyed upon) is not to be neglected; for though the Water be a fluid Body, yet is it a continued Body, and its imaginary Particles are built up from the Baſe of the Veſſel or Pond, invironing the included Body of the Diver, or other Body, and do thereby protect it from any conſiderable preſſure.

And the inſtances of the minute Bodies of Sand, Wheat, Hail-ſhot, *&c.* though not ſo ſubtil as the minute Particle of Water, yet hold analogy with it as to the mechanical part: And the inſtance given in the fourth Chapter of the *Obſervations upon the Torricellian Experiment, pag.* 64, 65, 66, and 67, *of the different Gravitation of Water upon Mercury in a Siphon*, do ſomewhat more explain it.

Chap. 8. This Chapter gives the prin-

principal, ſpecifical, and natural Reaſon of the exemption of the Bodies of divers, *&c.* from the vaſt preſſure of the impending Column of Water, which is alſo abundantly confirmed by the very near equal weight of Bodies in ſhallower or deeper immerſions, whereof in the third Chapter of the *Obſervations upon the Torricellian Experiment, pag.* 43. and the Notes upon it.

Againſt this it is objected, that ſolid Bodies have a lateral preſſure, as well as Fluids; and Inſtances given of a Bowl rolling down a ſloaping Hill, and ſome other of like nature; and ſo the lateral preſſure of Fluids makes nothing in the caſe.

I Anſwer:

Solid Bodies have two kinds of Motions: 1. That which is natural to them, which they alwayes affect, if not accidentally impeded,

and that is ever perpendicular, and only ſuch. 2. That which is accidental, or forced by ſome other accident, ſuch is the lateral diſcent of a Bowl down a Hill, or upon a ſloaping Board; nay ſuch is alſo that of reſilition or reflection, being let fall upon a hard Pavement.

But fluid Bodies have, Firſt, an accidental lateral Motion, as well as Solids; as where a River runs down a ſloaping Hill. Secondly, They have alſo, as they are heavy Bodies, a perpendicular Motion, as well as Solids, where they have a lighter *medium* through which they paſs; thus Water will Gravitate perpendicularly through Air, and Mercury through Water. Thirdly, But they have alſo a ſpecifical Motion or Gravitation of their own, as they are fluid Bodies, and naturally ariſing from their frame and texture; And this is laterally every

every way Horizontally or inclining, or declining, which is as natural to its conſiſtence and texture, as its perpendicular motion.

And this Motion diſcovers it ſelf plainly to be Intrinſecal or Natural, and ariſing from its texture, and conſiſtence: For let the Water, yea or Mercury, be put into a Veſſel, whoſe ſides are inclining, or ſimply Vertical, let its Baſe be paralel to the Horizon, or inclining to it, yet the included Water or Mercury, and every Particle of it, will have thoſe lateral Gravitations *quaqua verſum*, as well as perpendicular, though there be no Orifice in the Veſſel to give it paſſage: And therefore, if the Veſſel be not tight in the Sides as well as in the Bottom, the Water by this lateral preſſure upon the whole Sides, will drive them out, and this is that Gravitation which concerns it

it as a Fluid Body, and therein is natural to it.

And these several Motions, *Conatus ad motum*, or Gravitations, *viz.* the lateral and perpendicular, do mutually correct each other, so that no one parcel of the Water doth exercise its whole Gravitation, either entirely laterally, or entirely perpendicularly, upon any solid Body that lies in it, narrower than the Vessel, which seems to be the true reason of the Indolence of divers, and is the subject of the eighth Chapter.

And that every Particle of Water hath naturally as well a lateral, as a perpendicular Gravitation, appears by the comon instance, take a Cilindrical Vessel of Water, of six Inches Diameter, and take a Rundle of light Wood, of the Diameter of five Inches, press this Rundle to the bottom, if the Cilinder

linder of five Inches of Water did Gravitate perpendicularly only upon the Rundle, it would never be driven up, for that Cilinder of Water exceeds all the reſt of the Water in the Veſſel, but yet experience ſhews us, it will be driven up, and therefore even this Cilinder of Water, by a lateral preſſure, *per declive*, preſſeth round the ſides of the Rundle, and drives it up as well as the lateral Water.

Upon the whole matter, I do not at all find the ſuppoſition delivered in the Pamphlet called the *Eſſay*, nor the Reaſons thereof any way weakned, by the Objections made againſt it; nor any better Solution given inſtead thereof.

FINIS.

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